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Observations on the southern African fissurellids *Cosmetalepas africana* and *Macroschisma africana* (Mollusca: Gastropoda: Fissurellidae)

by

D. G. Herbert
(Natal Museum, Pietermaritzburg, South Africa)

ABSTRACT

The external anatomy and radula of *Cosmetalepas africana* (Tomlin, 1926) and *Macroschisma africana* (Tomlin, 1932) are described and figured, and biological notes on both species are given. The systematic positions of the two genera are discussed in the light of these observations. The relationships of *Cosmetalepas* are currently uncertain whilst *Macroschisma* clearly belongs in the Fissurellinae. A note on the correct spelling of *Macroschisma* is appended.

INTRODUCTION

Cosmetalepas africana (Tomlin, 1926) and *Macroschisma africana* (Tomlin, 1932) belong to two of the more poorly known fissurellid genera. The anatomy of neither species has been described previously although Odhner (1932) in his survey of fissurellid anatomy briefly discussed the anatomy of two congeners, *Cosmetalepas concatenata* (Crosse & Fischer, 1864) and *Macroschisma lischkei* Pilsbry, 1894. The following study was conducted in order to confirm and extend Odhner's observations and to provide SEM data on radula form.

C. africana is a relatively common species in southern African waters, ranging from Cape Agulhas to Zululand. It is normally only encountered as beached shells and the living animal has very rarely been found. Several examples, however, have recently been collected with the aid of underwater breathing apparatus. The only documented record of a living specimen prior to this was that of Barnard (1963). He briefly described its radula and figured the 5th lateral tooth. Torr (1914) and Odhner (1932) have figured the radula of *C. concatenata* and Cotton (1959) commented on the appearance of living specimens of that species.

M. africana is not uncommon as a beached shell on the East African coast between south-western Transkei and northern Mozambique. Again, however, living specimens are rarely encountered. There are no prior records of live-taken specimens and only four such examples are known to me. The radula of congeners *M. maxima* Adams, 1851 (as *M. macroschisma* Chemnitz, see Cernohorsky 1974) and *M. lischkei* Pilsbry 1894, have been figured by Thiele (1891) and Odhner (1932) respectively. That of *M. africana* was previously unknown. Adams (1867) and Schepman (1908) have briefly described and figured the external anatomy of *M. sinensis* Adams, 1855 and *M. maxima* Adams, 1851 respectively.

MATERIALS AND METHODS

Preserved specimens of *C. africana* were kindly provided by Mr Brian Hayes of Port Elizabeth. They were collected, using SCUBA, in Algoa Bay at a depth of approximately 10–15 m. An additional specimen was dredged by the Natal Museum off East London in 90 m. Three live-taken specimens of *M. africana* were available for study, one collected intertidally (D. Herbert & R. Kilburn) at Mtwalumi on the Natal south coast, another dived (D. Herbert) in 10–15 m on Tiffany's Reef, off Salt Rock, on the Natal north coast and the third collected by Mrs E. Roscoe in the Bazaruto Archipelago, Mozambique. A radula slide of a fourth specimen collected intertidally at Durban (R. Kilburn) was also examined.

Radulae for SEM were dissected, macerated in dilute NaOH, sonicated briefly, air-dried via alcohol and mounted on stubs using double-sided tape. Gold coated specimens were then examined at low accelerating voltage (10 kv or less) in a JeolT/2000 scanning electron microscope.

RESULTS

Cosmetalepas africana

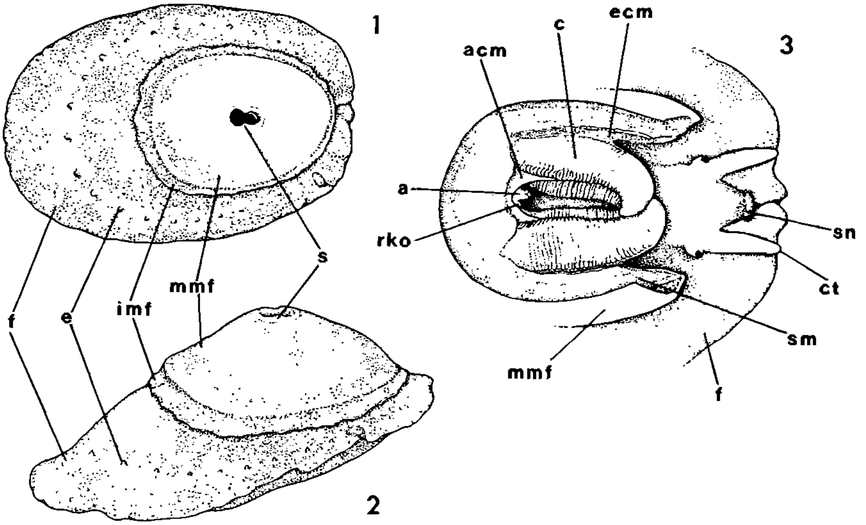
(Figs 1–7)

External anatomy (Figs 1–3): Animal considerably larger than shell which lies close to anterior end, tilted down toward head and almost entirely covered by mantle. Body colour variable, ranging from cream to orange, sometimes with a degree of black speckling anteriorly, particularly on sides of foot and head.

Head small, dome-like and as there is virtually no neck, appears perched on anterior of foot (Fig. 3). Cephalic tentacles stout, probably highly extensile and not obviously papillate. They lie on either side of the rather conspicuous forehead. Eyes black, each situated at end of a very short stalk, fused to base of cephalic tentacles. Right postoptic tentacle absent. Snout smooth, tapers towards tip which is bluntly truncated. Lips smooth or slightly lobed, round to ovate (long axis antero-posterior) and incomplete posteriorly (ventrally) in mid-line. Cephalic lappets and neck lobes absent.

Foot circular to oval, extending well beyond edge of shell and mantle skirt, particularly posteriorly. Propodium somewhat flattened with a deep, rounded embayment in mid-line, into which snout protrudes. Lateral portions of embayment extend forward such that they meet anteriorly, totally encircling snout. There is no epipodial fold and sensory specialisations typical of that region are restricted to a series of small wart-like papillae (probably epipodial sense organs), *ca* 13 on each side, lying between pedal margin and mantle skirt. In some specimens these may be very indistinct as there is no differential coloration.

Inner mantle fold forms a relatively narrow skirt around upper portion of foot. Middle fold is reflected dorsally and, during life, covers almost entire shell, leaving only area immediately around foramen open. Its under surface (originally dorsal) usually flecked with black. Outer mantle fold thin and narrow, and always covered by middle fold. Inner fold forms a short siphon in region of foramen and



Figs 1–3. *Cosmetalepas africana*, external anatomy and morphology of the mantle cavity. 1–2, dorsal and lateral views of preserved animal, mantle drawn as in life (X2). 3, head and mantle cavity exposed by removal of shell and roof of mantle cavity (X3). a, anus; acm, afferent ctenidial membrane; c, ctenidium; ct, cephalic tentacle; e, epipodium; ecm, efferent ctenidial membrane; f, foot; imf, inner mantle fold; mmf, middle mantle fold; rko, right kidney opening; s, shell; sm, shell muscle; sn, snout.

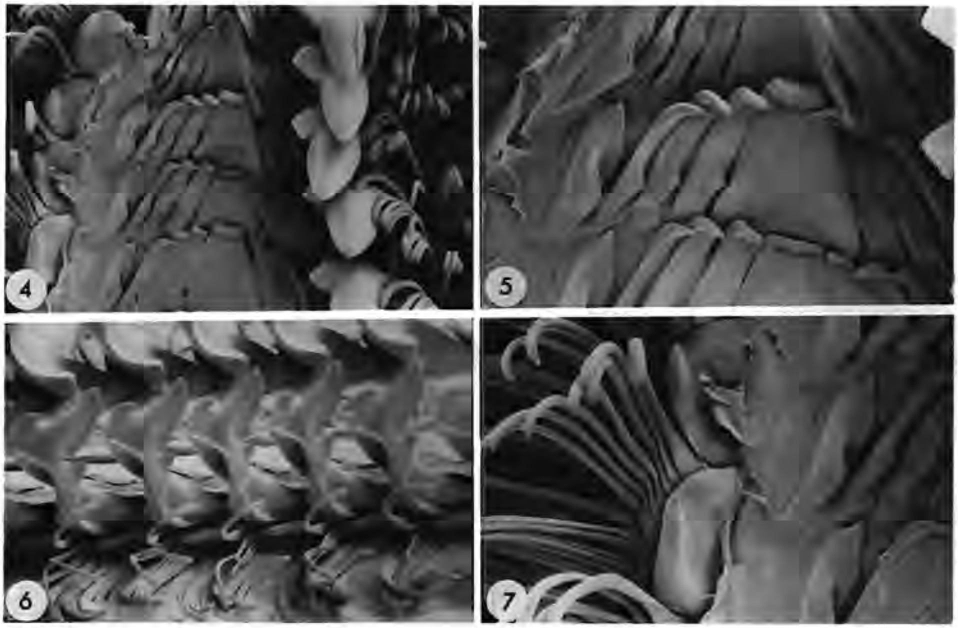
the middle fold a frill around foramen margin. A pair of pallial sense organs occurs between these folds, one on each side of mid-line. Their exact position and shape is variable; some appear rather tentaculiform.

Mantle cavity relatively wide, but not deep, corresponding to the shape of the shell. Ctenidia stout, bipectinate and attached to body wall by their efferent membranes for ½–⅔ of their length. Ventral filaments slightly larger than dorsal ones. The anus projects on a stalk arising below the junction of the afferent ctenidial membranes. Right and left kidney openings visible below this; the right somewhat larger than the left. I have not been able to observe the hook-shaped projections at the anterior ends of the shell muscle as figured by Odhner (1932: fig. 39a). Muscle scar on shell interior is generally poorly defined and rarely shows more than a slight swelling at its anterior ends.

Biological notes: *C. africana* is normally a sublittoral species, ranging from just below tide level (10 m) to *ca* 100 m, although Hayes (pers. comm.) has collected one specimen intertidally. It is usually found under rocks and/or on sponges. Gut contents consist almost entirely of astrous microscleres of tetractinellid sponges. This is true of both shallow and deeper water specimens and suggests a rather restricted diet. The specimen from deeper water also contained tests of *Globigerina*-like foraminiferans, but these may represent dead detrital material ingested fortuitously.

In its natural habitat the overall appearance of the animal, like that of other large-bodied fissurellids (*Fissurellidea* group), is more like a dorid nudibranch than a limpet (McLean 1984). The variable colour of the soft parts is almost certainly a function of diet and aids in crypsis. Cotton (1959) also reported variable coloration in *C. concatenata*.

Radula (Figs 4–7): Formula (20–30) + 1 + (1 + 4) + 1 + (4 + 1) + 1 + (20–30), *ca* 40 transverse rows of teeth. Rachidian broad basally, tapering evenly toward the cutting edge; basal width of rachidian more or less equal to length; cutting edge roughened, but not denticulate. Inner three laterals narrow, not obviously tapering, cutting edge of first relatively broad, becoming progressively narrower and more pointed toward the third; fourth lateral broader, but with no cutting edge. A ridge-like, medially directed process is evident near the base of each inner lateral, weak on the first becoming progressively more prominent toward the fourth. Fifth lateral large, apex with three cusps, the middle one of which is much the largest, and the outer one smallest; underside strongly excavated to accommodate shaft of preceding tooth (Fig. 6). Latero-marginal plate triangular to semicircular with a weak, anteriorly directed apical point which fits into a groove on the outer edge of the fifth lateral (Fig. 7). Marginals relatively broad basally, but narrowing rapidly and becoming curved distally; apex finely denticulate on both sides; 20–30 in total, the first 12–15 of which lie behind the latero-marginal plate and overlap those of the preceding row.

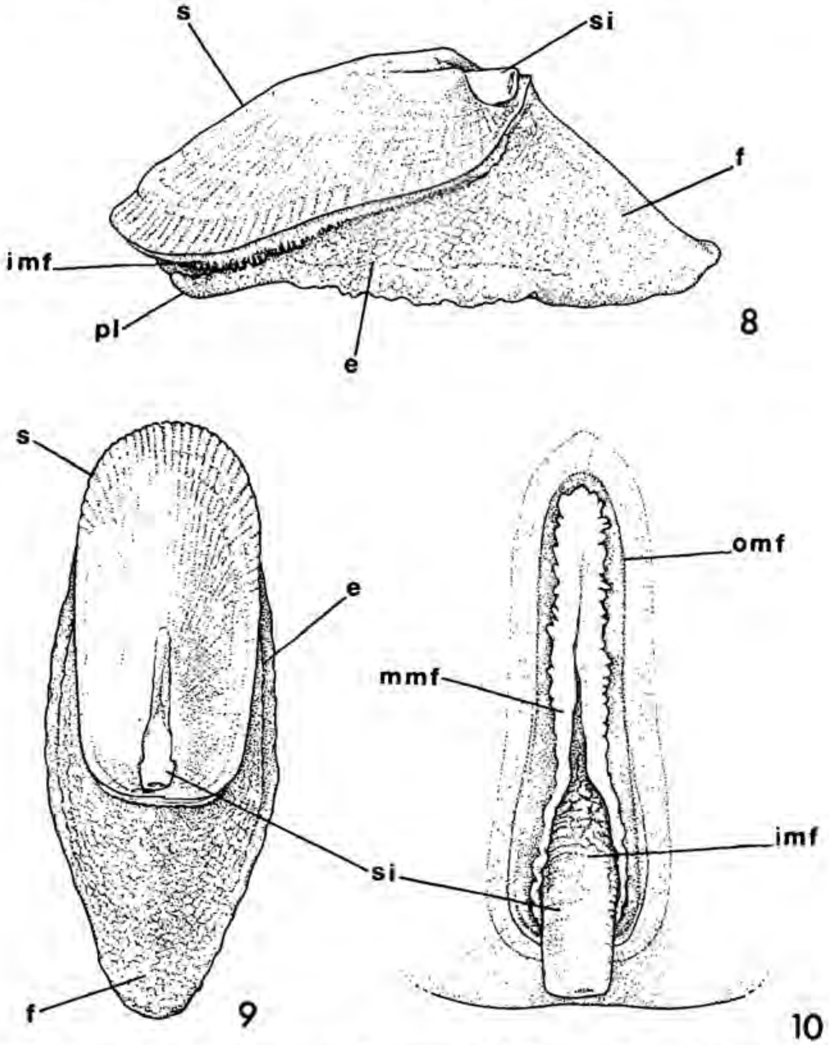


Figs 4–7. *Cosmetalepas africana*, radula (*ex* NM B7827). 4, transverse rows of teeth with fifth laterals on left removed (X50). 5, rachidian and inner laterals (X100). 6, side view of fifth laterals (X50). 7, latero-marginal plates exposed by removal of the fifth laterals (X100).

Macroschisma africana
(Figs 8–17)

External anatomy (Figs 8–13): Animal, like the shell, is markedly elongate and superficially resembles a terrestrial slug. Shell much smaller than animal and lies anteriorly, noticeably sloping down toward head (Fig. 8). Foot extends well beyond posterior edge of shell. Body colour largely white to cream with patches of black pigmentation on foot. Cephalic tentacles orange-red to maroon during life.

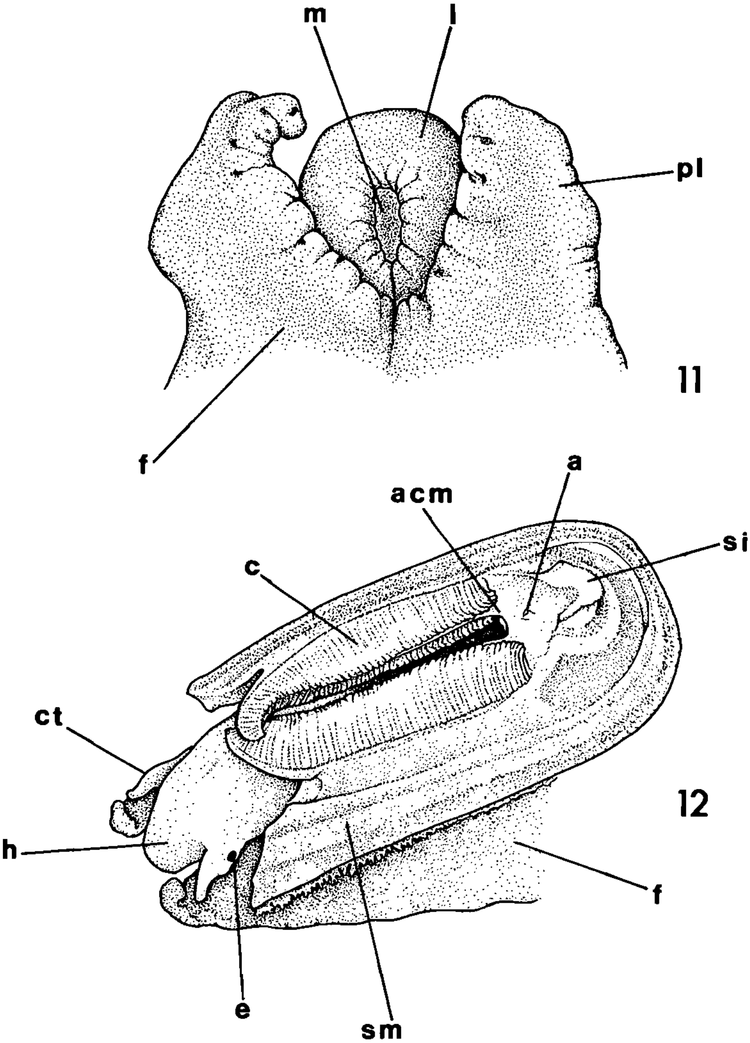
Head large and broad with cephalic tentacles placed laterally. These are not ob-



Figs 8–10. *Macroschisma africana*, external anatomy. 8–9, lateral and dorsal views of preserved animal (X6,5). 10, detail of mantle edge bordering the shell foramen (shell removed) (X20). e, epipodium; f, foot; imf, inner mantle fold; mmf, middle mantle fold; omf, outer mantle fold; pl, propodial lobe; s, shell; si, siphon.

viously papillate and, though capable of being extended well beyond the shell, are not large. Eye-stalks almost completely fused to cephalic tentacle bases; eye black. There is no right postoptic tentacle. Snout smooth, tapering slightly and bluntly truncated. Mouth antero-posteriorly elongate, and lips gently lobed and incomplete posteriorly in the mid-line. There are no cephalic lappets or neck lobes.

Foot broadest at hind end of shell (in preserved state), its surface finely reticulated throughout and with a faint ridge on each side, probably representing the epipodial fold. This commences below eye and runs parallel with edge of sole,



Figs 11–12. *Macroschisma africana*, anatomy. 11, ventral view of anterior of foot and snout (X25). 12, head and mantle cavity exposed by removal of shell and roof of mantle cavity (X10). a, anus; acm, afferent ctenidial membrane; c, ctenidium; ct, cepahlic tentacle; e, eye; f, foot; h, head; l, lips; m, mouth; pl, propodial lobe; si, siphon; sm, shell muscle.

evanescing just posterior to shell. It is most obvious anteriorly where it appears to bear weak papillae, probably epipodial sense organs. There are no discrete tentacles. Anterior pedal margin deeply bifurcated producing two propodial lobes which lie on either side of snout (Fig. 11).

Mantle edge relatively poorly developed compared to that of *C. africana*. Outer and middle folds not hypertrophied and simply lie against shell margin. Inner fold narrow posteriorly, but expands anteriorly and forms a fimbriate skirt extending a short distance from shell margin (Fig. 13). Mantle edge bordering shell foramen (Fig. 10) more specialised: its outer and middle folds essentially unmodified, although middle one slightly enlarged and frilled in the narrow anterior portion; together these folds encircle entire foramen margin. Inner fold bordering foramen for the most part fused and closes off anterior portion. Posteriorly, however, it is drawn out into a well developed, relatively thick-walled siphon which protrudes posteriorly through foramen.

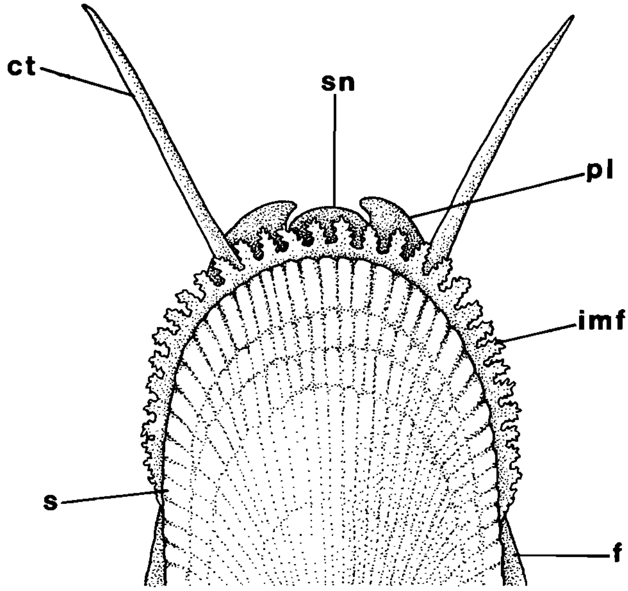
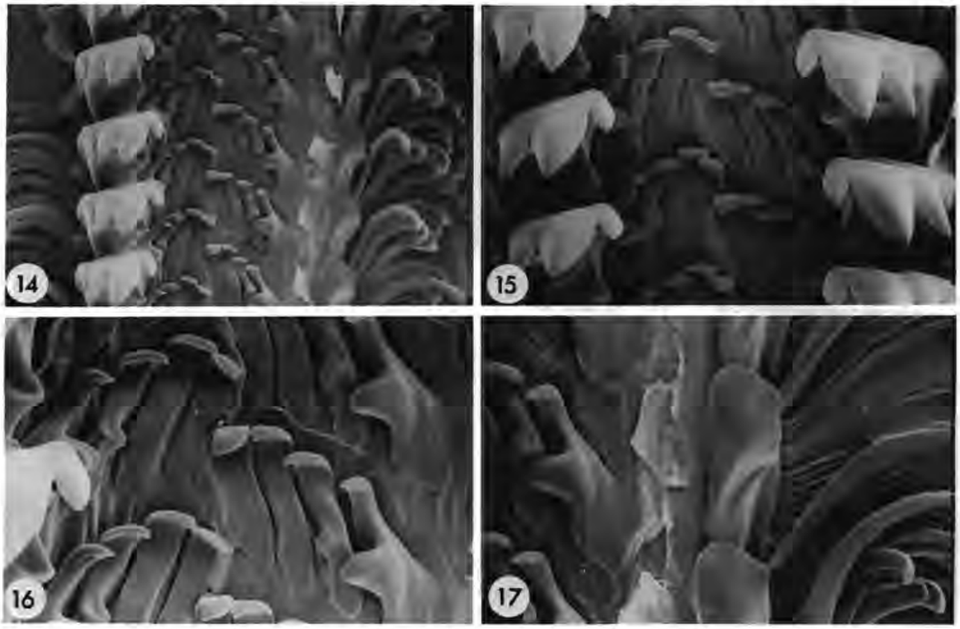


Fig. 13. *Macroschisma africana*, dorsal view of anterior end of living animal (X17). ct, cephalic tentacle; f, foot; imf, inner mantle fold; pl, propodial lobe; s, shell; sn, snout.

Mantle cavity narrow and elongate, much the same shape as shell (Fig. 12). The entrance is somewhat restricted because of the reduced width and large head, and consequently water flow must be mainly in an antero-posterior direction. Ctenidia elongate and attached by the efferent membrane to side wall of cavity for most of their length. They are bipectinate with the filaments on either side of the central axis more or less symmetrical. The anus lies within the base of siphon, above the junction of afferent ctenidial membranes. It may lie level with siphon wall, or be raised on a short papilla. Opening of right kidney lies below afferent ctenidial membrane, slightly to right of mid-line; that of left kidney was not observed. Shell muscle has no hook-shaped processes anteriorly, but may be slightly expanded in that region.

Biological notes: *M. africana* is a shallow-water species occuring from LWST to 50 m, but too few live-taken specimens are known to give meaningful bathymetric data. Fresh shells have been dredged down to 60 m. Three of the four live-taken specimens known to me were found living under rocks lying on sand or on rocks covered with sand. No data are available for the fourth. Cotton (1959) described a similar habitat for *M. bakiei* Adams in Sowerby, 1862. One specimen of *M. africana*, examined whilst crawling over a partially sand-covered rock, moved in a forward direction until it reached the rock/sand interface, whereupon it turned around and proceeded beneath the sand, backwards. The function of the propodial lobes is not known. They are not obviously used in feeding, which is achieved by simple rasping of the surface. A role in sensory perception and/or locomotion is more probable. In upturned individuals the lobes are expanded and actively moved around until a firm object suitable for righting is located. A role in the detection of food material is also possible. Gut contents include filamentous algal material and indicate a largely herbivorous diet.

Radula (Figs 14–17): Formula (10–20) + 1 + (1 + 4) + 1 + (4 + 1) + 1 + (10–20); *ca* 50 transverse rows of teeth. Rachidian very weak and lacking a distinct shaft and cusp (Fig. 16); basal portion stains weakly in light microscope preparations, but wrinkles up when air-dried for SEM; basal width similar to that of inner



Figs 14–17. *Macroschisma africana*, radula (*ex* NM D4361). 14, whole transverse rows of teeth with fifth lateral on right removed (X110). 15, central portion of transverse row (X190). 16, rachidian and inner laterals (X260). 17, latero-marginal plate exposed by removal of the fifth lateral (X260).

laterals. Inner laterals four on each side, those on the left much more anterior than those on the right. Cusp of first lateral on right strongly curled over, others less so; cutting edges roughened, but not denticulate, that of fourth lateral pointed toward mid-line. Fourth lateral also with a well-developed alate expansion near its base, which overlaps the third lateral; third lateral with a weak one. Fifth lateral very large, with four triangular cusps, the middle pair of which are largest and the outermost one smallest (Fig. 15). Latero-marginal plate more or less oblong, concave medially and postero-laterally to accommodate the fifth lateral and marginals respectively, when folded (Fig. 17). Marginals 10–20 on each side, flattened and curved, with rounded, finely denticulate tips.

DISCUSSION

Cosmetalepas Iredale, 1924, is usually referred to the Emarginulinae or Diodorinae, although Keen (1960) and Christiaens (1973) grouped it in the Fissurellinae and Fissurellidinae respectively. McLean (1984*a*), utilising only two subfamilies within the Fissurellidae, classified it in the Tribe Diodorini within the Emarginulinae.

The radula is emarginuline in its possession of a relatively broad rachidian, but the tricuspid fifth lateral, which is also present in *C. concatenata* (Torr 1914, Odhner 1932) is unusual. In this last respect it is similar to *Monodilepas* Finlay, 1927, and indeed Finlay, in his original description, compared *Monodilepas* with *Cosmetalepas*. Dell (1953) also believed the two genera to be closely related. Keen's (1960) treatment of *Monodilepas* as a synonym of *Diodora* is puzzling. McLean (1984*a*) indicated that both *Cosmetalepas* and *Monodilepas* have hook-shaped ends to the muscle scar and used this in support of placing them in the Diodorini. Although Odhner (1932) clearly figured such processes in *C. concatenata*, I cannot confirm their presence in *C. africana*.

The enlarged foot and mantle of *Cosmetalepas* is more typical of a member of the Fissurellidini (see McLean 1984*a*) rather than the Diodorini. Moreover, *Cosmetalepas* lacks a depression posterior to the callus ring bordering the foramen. However, the mantle is generally more hypertrophied in the Fissurellidini, and covers both the shell and foot. Members of the Fissurellinae have a quadricuspid fifth lateral and large-bodied genera are more elongate with the shell rarely if ever covered by the mantle.

Currently *Cosmetalepas* and *Monodilepas* do not appear to fit well into any of the fissurellid subgroupings. Clearly the problem merits an in-depth study, but this must await an assessment of the relative importance and significance of the various character states at present used within the classification of Fissurellidae.

Much less uncertainty surrounds the relationships of *Macroschisma* Sowerby, 1835, which on the basis of its radula form is traditionally placed in the Fissurellinae. The present observations support this and furthermore the algal diet of *Macroschisma* is a fissurelline trait, not an emarginuline trait (McLean 1984*b* and pers comm.). Christiaens (1973), however, grouped it with other large-bodied genera in the subfamily Fissurellidinae. McLean (1984*a*) stated that the large outer lateral of *Macroschisma* had only three cusps, but this is not in agreement with the present observations or those of previous authors (Thiele 1891, Odhner 1932). The poorly developed rachidian appears to be an autapomorphy and probably represents an advanced state in a trend inherent within the Fissurellinae.

The external anatomy of *Macroschisma* with its slug-like appearance and reduced epipodium is typical of large-bodied fissurellids. Unlike members of the Fissurellidini, however, the body is markedly elongate and only the foot is enlarged, the mantle being relatively poorly developed. Greatest anatomical similarity is shown with the *Amblychilepas* group of genera (see McLean & Kilburn 1986), and the propodial specialisations, though clearly less elaborate, are reminiscent of those in *Medusafissurella* McLean & Kilburn, 1986 and *Dendrofissurella* McLean & Kilburn, 1986.

NOTE: There has been little agreement regarding the authorship, spelling and type species of *Macroschisma* (see also Macpherson & Gabriel 1962). Sowerby, in his Conchological Illustrations mentioned the name *Macroschisma* giving Gray as its originator, although, he (Sowerby) did not seem to regard it as distinct from *Fissurella* and presumably believed it to be a synonym. Under Art. 11e of the ICZN (1985) rules, this name is still available as it has been treated as an available name prior to 1961 (Habe 1951, Cotton 1959, Keen 1960). Furthermore, according to Art. 50 g of the same rules it is Sowerby who must be regarded as author. He spelt the name with the extra 's' and thus under Art. 32*a*, *b*, this is the correct spelling. The date of publication of the catalogue of the fissurellid section of Sowerby's 'Illustrations' was 1835 (Shaw 1909). *Macroschisma* thus predates both *Macrochisma* Gray, 1840, and *Machrochisma* Swainson, 1840. The type species (by monotypy) is *Macroschisma macroschisma* Sowerby, 1835, the true identity of which is uncertain (see Christiaens 1987). *Patella macroschisma* Lightfoot, 1786, must be considered a *nomen dubium* (Rehder 1967) and *Patella macroschisma* Holten, 1802, is *Macroschisma maxima* A. Adams, 1851 (Cernohorsky 1974). There is much uncertainty regarding the number of valid species within *Macroschisma* and a world-wide revision of the genus is required.

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